Taxon: Limnobium spongia **Family:** Hydrocharitaceae

Common Name(s): American spongeplant
frog's-bit

Synonym(s): Hydrocharis spongia Bosc

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 11 Aug 2015

WRA Score: 18.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Aquatic, Weedy, Smothering, Water-Dispersed, Spreads Vegetatively

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)		
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	?
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y
303	Agricultural/forestry/horticultural weed		
304	Environmental weed		
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals		
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	y
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	y
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)		
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	n
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	No evidence

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	NA

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed 10 Aug 2015]	"Native: NORTHERN AMERICA Northeastern U.S.A.: United States - New York [w.] North-Central U.S.A.: United States - Illinois [s.], Missouri [s.e.], Oklahoma [s.e.] Southeastern U.S.A.: United States - Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky [w.], Louisiana, Maryland, Mississippi, North Carolina [e.], South Carolina, Tennessee, Virginia South-Central U.S.A.: United States - Texas"

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed 10 Aug 2015]	

203	**Broad climate suitability (environmental versatility)**	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Les, D. H., & Mehrhoff, L. J. (1999). Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions, 1(2-3): 281-300	"Frogbit may fail to thrive in the northeast because of its tropical affinities (Lowden 1992), or the scarcity of alkaline, hardwater, nutrient-rich lakes where it tends to occur (Hoyer et al. 1996)." ... "Limnobium is not well established in the northeast, possibly because of the cool climate and widespread occurrence of acidic, softwater habitats."
	Pond Megastore. 2015. Frogbit (Limnobium spongia) Frog's Bit. https://www.pondmegastore.com/shop/product.php?productid=16297. [Accessed 10 Aug 2015]	"Hardiness Zones: 7 through 12"
	Hrusa, G.F. 1999. Limnobium spongia L. sensu lato. Calfornia Plant Pest & Disease Report 18(1-2): 46-49	"Limnobium spongia is hardy to temperatures well below those known in low elevation California. " ... "Limnobium spongia is hardy to temperatures well below those known in low elevation California."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	Tiner, R.W. 1993. Field Guide to Coastal Wetland Plants of the Southeastern United States. University of Massachusetts Press, Amherst, MA	[Present in tropical America] "Range: New Jersey south to northern Florida, west to eastern Texas, and north to southern Illinois; also in Lake Ontario and tropical America."

205	Does the species have a history of repeated introductions outside its natural range?	?
	Source(s)	**Notes**
	Sutton, D.L. 1991. The Hydrocharitaceac or Frog's-bit Family. Aquatics 13(1): 4-12	"Species of the Frog's-bit family have been introduced to many countries around the world and are now naturalized in a number of them. Often these introductions have resulted in the plants becoming weed problems."

301	Naturalized beyond native range	y
	Source(s)	**Notes**
	Islam, M.S. 2012. Study on the Aquatic Weeds of Haor Area at Karimgonj Upazilla of Kishoregonj District. MS Thesis. Bangladesh Agricultural University, Mymensingh	"4.2 List of aquatic weeds which found ten years ago in haor at kishoregonj Table 1. List of emergent weeds" [Includes Limnobium spongia]
	Hrusa, G.F. 1999. Limnobium spongia L. sensu lato. Calfornia Plant Pest & Disease Report 18(1-2): 46-49	"Limnobium spongia sensu stricto has become established in several states west of its native range, although at present only Limnobium laevigatum has been found introduced into the wild in California, likely because it is the only one currently sold as an ornamental."

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	Madsen, J. D., Owens, C. S., & Getsinger, K. D. (1998). Evaluation of four herbicides for management of American frogbit (Limnobium spongia). Journal of Aquatic Plant Management, 36: 148-150	"Although a native plant, American frogbit can produce extensive floating mats and create nuisance situations, such as blocking navigation, affecting water quality, fish and wildlife habitat, and recreational usage."

Qsn #	Question	Answer
	Weaver, Jr., R.E. & Anderson, P.J. 2010. Botany Section. TRI-OLOGY 49(5):	"Although this is a native plant and therefore, not an invasive exotic, it can grow rampantly. Dense mats of this plant can cover other aquatic vegetation, much like Eichhornia crassipes, the invasive water hyacinth."
	Les, D. H., & Mehrhoff, L. J. (1999). Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions, 1(2-3): 281-300	"Limnobium spongia is included with 'nonindigenous aquatic monocots' because it has been introduced outside of its former range (http://nas.er.usgs.gov/monocots/monocotslist.htm). Although native to North America, frog-bit is capable of weedy growth. Steward (1990) listed L. spongia among problematic aquatic plants in the eastern USA, but not as a major weed. Knight (1985) indicated that Limnobium was as troublesome as nonindigenous species. It is difficult to control and can assume 'water hyacinthlike growth' in some Florida localities (Knight 1985; Bodle 1986). It hinders navigation in the St. John's River, Florida where it is targeted for control more often than water hyacinth (Knight 1985)."

303	Agricultural/forestry/horticultural weed	
	Source(s)	**Notes**
	Madsen, J. D., Owens, C. S., & Getsinger, K. D. (1998). Evaluation of four herbicides for management of American frogbit (Limnobium spongia). Journal of Aquatic Plant Management, 36: 148-150	[Potentially] "Although a native plant, American frogbit can produce extensive floating mats and create nuisance situations, such as blocking navigation, affecting water quality, fish and wildlife habitat, and recreational usage."

304	Environmental weed	
	Source(s)	**Notes**
	Madsen, J. D., Owens, C. S., & Getsinger, K. D. (1998). Evaluation of four herbicides for management of American frogbit (Limnobium spongia). Journal of Aquatic Plant Management, 36: 148-150	[Potentially] "Although a native plant, American frogbit can produce extensive floating mats and create nuisance situations, such as blocking navigation, affecting water quality, fish and wildlife habitat, and recreational usage."

305	Congeneric weed	y
	Source(s)	**Notes**
	DiTomaso, J.M./Kyser, G.B. et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	"Limnobium laevigatum ... Impacts: Can form dense stands in aquatic systems and impede the flow of water. Also weedy in Canada and South America. Western states listed as Noxious Weed: California"

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	[No evidence] "Herbs, to 50 cm. Roots branched; stolon buds with 10 or more roots. Leaves floating or emersed in dense vegetation and when stranded; blade 1--10 ´ 0.9--7.8 cm; primary veins forming 30--80° angle with midvein, ascending, aerenchyma extensive, nearly margin to margin, individual aerenchyma space (located ca. 1 mm from either side of midvein) , 0.4--1.6 mm wide, 1 mm from midveinacross its longest axis."

Qsn #	Question	Answer
402	**Allelopathic**	
	Source(s)	**Notes**
	Elakovich, S. D., & Wooten, J. W. (1989). Aquatic Plant Control Research Program. Allelopathic Aquatic Plants for Aquatic Plant Management: A Feasibility Study. Technical Report A-89-2. University of Southern Mississippi, Hattiesburg, Mississippi	"Table 2 Results of Lettuce Seedling Radical Inhibition by Aqueous Extracts of Selected Aquatic Plants" ... "Table 4 Results of Lemna minor Dry Weight Reduction by Aqueous Extracts of Selected Aquatic Plants" [Limnobium spongia extracts inhibit growth of both test plants]
	Pedersen, O. (2002). Allelopathy—Chemical Warfare Between Aquatic Plants. The Aquatic Gardener, 15(3): 9-18	Limnobium spongia reported to be toxic to Lemna minor

403	Parasitic	n
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	"Herbs, to 50 cm." [Hydrocharitaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**
	USDA Natural Resources Conservation Service. 2015. Conservation Plant Characteristics - Limnobium spongia. http://plants.usda.gov/java/charProfile?symbol=LISP2. [Accessed 11 Aug 2015]	Palatable Browse Animal - Unknown Palatable Graze Animal - Unknown

405	Toxic to animals	n
	Source(s)	**Notes**
	USDA Natural Resources Conservation Service. 2015. Conservation Plant Characteristics - Limnobium spongia. http://plants.usda.gov/java/charProfile?symbol=LISP2. [Accessed 11 Aug 2015]	"Toxicity: None"
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	Joyner, B. G., & Freeman, T. E. (1973). Pathogenicity of Rhizoctonia solani to Aquatic Plants. Phytopathology, 63: 681-685	"A Rhizoctonia solani isolate (RhEa) from diseased anchoring hyacinth (Eichhornia azurea) in Panama was pathogenic to several aquatic plants, particularly to water hyacinth (E. crassipes) and water lettuce (Pistia stratioites)." ... "Symptoms induced by RhEa in other aquatics with large leaves (frogbit and pickerel weed) were similar to those on water hyacinth and water lettuce. However, secondary spread from the initial lesion was not as evident as on water hyacinth and water lettuce."

Qsn #	Question	Answer
	Conway, K. E. (1978). A new species of Cercospora from Limnobium spongia. Transactions of the British Mycological Society, 71(3): 521-523	[Host of Cercospora limnobii] "The preliminary successes in using Cercospora rodmanii Conway as a biological control for water-hyacinth (Eichhornia crassipes (Mart.) Solms) (Conway, 1976; Conway & Freeman, 1977) have stimulated interest in other diseases that affect aquatic plants. A serious blight of Frogbit (Limnobium spongia (Bosc.) Steud.) was noticed in 1975 in Rodman Reservoir..."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	USDA Natural Resources Conservation Service. 2015. Conservation Plant Characteristics - Limnobium spongia. http://plants.usda.gov/java/charProfile?symbol=LISP2. [Accessed 11 Aug 2015]	"Toxicity: None"
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	[No evidence. Aquatic] "Floating on slow-moving water of streams, bayous, and lakes or stranded along shore"

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	**Notes**
	Martin, A.C. & Uhler, F.M. 1939. Food of game ducks in the United States and Canada. Technical Bulletin No. 634. USDA, Washington, D.C.	"Environment. - The plants float on the surface of fresh-water ponds and swamps or grow on muddy bottoms from which the water has receded. They withstand a considerable degree of shade."
	Pond Megastore. 2015. Frogbit (Limnobium spongia) Frog's Bit. https://www.pondmegastore.com/shop/product.php?productid=16297. [Accessed 10 Aug 2015]	"Light Conditions: full sun to full shade"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	**Notes**
	USDA Natural Resources Conservation Service. 2015. Conservation Plant Characteristics - Limnobium spongia. http://plants.usda.gov/java/charProfile?symbol=LISP2. [Accessed 11 Aug 2015]	Adapted To Coarse Textured Soils: No Adapted To Medium Textured Soils: Yes Adapted To Fine Textured Soils: Yes pH, Minimum: 5.0 pH, Maximum: 5.9 Salinity Tolerance: None

411	Climbing or smothering growth habit	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Center for Aquatic and Invasive Plants. 2014. Frog's-bit, American spongeplant. Limnobium spongia. University of Florida, Gainesville, FL. http://plants.ifas.ufl.edu/node/233. [Accessed 10 Aug 2015]	[Smothers water surfaces] "Frog's-bit is a native plant that can be floating or rooted. It occurs in many water types throughout Florida. It can form dense mats that crowd out almost all other plants."

412	Forms dense thickets	n
	Source(s)	**Notes**
	Center for Aquatic and Invasive Plants. 2014. Frog's-bit, American spongeplant. Limnobium spongia. University of Florida, Gainesville, FL. http://plants.ifas.ufl.edu/node/233. [Accessed 10 Aug 2015]	[Forms dense, smothering mats] "Frog's-bit is a native plant that can be floating or rooted. It occurs in many water types throughout Florida. It can form dense mats that crowd out almost all other plants."

501	Aquatic	y
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	"Floating on slow-moving water of streams, bayous, and lakes or stranded along shore"
	Tiner, R.W. 1993. Field Guide to Coastal Wetland Plants of the Southeastern United States. University of Massachusetts Press, Amherst, MA	"Habitat: Tidal fresh marshes and rivers; slow-flowing rivers, non tidal marshes, ponds, lakes, ditches, and swamps."

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed 10 Aug 2015]	"Family: Hydrocharitaceae subfamily: Hydrocharitoideae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	"Herbs, to 50 cm." [Hydrocharitaceae. No evidence]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	"Herbs, to 50 cm. Roots branched; stolon buds with 10 or more roots."

Qsn #	Question	Answer
601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Flora of North America Editorial Committee. 2000, Flora of North America: North of Mexico, Volume 22. Oxford University Press, Oxford, UK	No evidence

602	Produces viable seed	y
	Source(s)	**Notes**
	Hrusa, G.F. 1999. Limnobium spongia L. sensu lato. Calfornia Plant Pest & Disease Report 18(1-2): 46-49	"Both reproduce rapidly by both seed and stolons, quickly filling newly colonized sites with both clones and new individuals,"
	Les, D. H., & Mehrhoff, L. J. (1999). Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions, 1(2-3): 281-300	"However, its ability to reproduce both vegetatively and by seed is worrisome."

603	Hybridizes naturally	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown. No evidence found

604	Self-compatible or apomictic	
	Source(s)	**Notes**
	Sutton, D.L. 1991. The Hydrocharitaceac or Frog's-bit Family. Aquatics 13(1): 4-12	[Unlikely. self-pollination prevented] "Small male and female flowers borne on short stalks are found on American Frog's-bit. Although male and female flowers occur on the same plant, they develop at different times to prevent self-pollination. After pollination the female flower coils downward and seed development occurs underwater."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Cook, C. D. (1988). Wind pollination in aquatic angiosperms. Annals of the Missouri Botanical Garden, 75 (3): 768-777	"Within the Hydrocharitaceae, Limnobium is the only genus with dry, powdery, and buoyant pollen that is transported to the stigmas by movements of air and thus can be called anemophilous."
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	[Wind-pollinated] "Pollen transferred through air. In Limnobium (Fig. 62D,E), described in detail by Cook and Urmi-Konig (1983c), the male flowers are held above the females. Pollen is liberated from the anthers, where it is either directly blown away or falls onto the spreading sepals where it may be further transported by wind or fall as the sepals wither."

606	Reproduction by vegetative fragmentation	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Hrusa, G.F. 1999. Limnobium spongia L. sensu lato. Calfornia Plant Pest & Disease Report 18(1-2): 46-49	"Both reproduce rapidly by both seed and stolons, quickly filling newly colonized sites with both clones and new individuals, and both are often considered pestiferous even in their native ranges."
	Les, D. H., & Mehrhoff, L. J. (1999). Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions, 1(2-3): 281-300	"However, its ability to reproduce both vegetatively and by seed is worrisome."
	Martin, A.C. & Uhler, F.M. 1939. Food of game ducks in the United States and Canada. Technical Bulletin No. 634. USDA, Washington, D.C.	"Propagation. - By young plants sprouted from the prostrate floating stems or rootstocks, and probably by seed."

607	Minimum generative time (years)	
	Source(s)	**Notes**
	USDA Natural Resources Conservation Service. 2015. Conservation Plant Characteristics - Limnobium spongia. http://plants.usda.gov/java/charProfile?symbol=LISP2. [Accessed 11 Aug 2015]	[Time to maturity unknown] "Growth Rate: Moderate"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	**Notes**
	Hrusa, G.F. 1999. Limnobium spongia L. sensu lato. Calfornia Plant Pest & Disease Report 18(1-2): 46-49	"Limnobium spongia sensu stricto has become established in several states west of its native range, although at present only Limnobium laevigatum has been found introduced into the wild in California, likely because it is the only one currently sold as an ornamental. Individual seeds are covered with small spinules and the seeds when shed are contained in a gelatinous mass; both forms readily attach to watercraft and if they should become established in navigable waterways are likely to spread rapidly and widely."

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Les, D. H., & Mehrhoff, L. J. (1999). Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions, 1(2-3): 281-300	"Its availability as a water garden and aquarium plant is generally limited, so introductions of this species beyond its native range would likely occur by waterfowl seed dispersal."
	Azan, S. S. E. (2011). Invasive aquatic plants and the aquarium and ornamental pond industries. MS Thesis. Ryerson University, Toronto, Canada	"Table 13: Invasive taxa with volume of sales (100500 total taxa sold per year in 20 stores reporting sales volume)" [Limnobium spongia included in list of plants sold by stores]

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown. Possibly could be dispersed if established with aquatic crops

704	Propagules adapted to wind dispersal	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Tiner, R.W. 1993. Field Guide to Coastal Wetland Plants of the Southeastern United States. University of Massachusetts Press, Amherst, MA	[No adaptations for wind dispersal] "somewhat roundish fleshy fruit bearing many seeds."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	California Department of Water Resources. 2015. Central Valley Flood System Conservation Strategy (Draft). California Natural Resources Agency, Sacramento, CA	"The small, floating seeds easily disperse along watercourses by wind, currents, tidal action, and waterfowl."
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	The seeds of Hydrocharis and Limnobium germinate at the water surface; at first, the testa is shed and the seedling floats on the surface."

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	Les, D. H., & Mehrhoff, L. J. (1999). Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions, 1(2-3): 281-300	"Limnobium has been collected only once in New England, when a few small plants were observed at a Mansfield, CT pond in 1998 (Les s.n., CONN). It was probably dispersed to this site by waterfowl." ... "Waterfowl consume Limnobium seeds, though they are utilized mostly in the Mississippi embayment area (Martin and Uhler 1939). The seeds are consumed by goldeneye, green wing teal, mallard, old squaw, pintail, ringneck, and wood ducks (Cottam 1939; Mabbott 1920; McAtee 1918, 1939). It is not a major waterfowl food, but its occasional use provides an avenue for seed dispersal. Because of natural dispersal (Lowden 1992), disjunct sites in New York and Connecticut probably originated from waterfowl. Martin and Uhler (1939) recommended propagation of Limnobium as a waterfowl food."
	Martin, A.C. & Uhler, F.M. 1939. Food of game ducks in the United States and Canada. Technical Bulletin No. 634. USDA, Washington, D.C.	[Presumably dispersed by ducks] "Value. - Fair locally; though frogbit occurs throughout the South, it has been recorded from duck stomachs in significant percentages only in Avoyelles Parish, La." ... "Parts consumed. many-seeded fruit."

707	Propagules dispersed by other animals (externally)	
	Source(s)	**Notes**
	Hrusa, G.F. 1999. Limnobium spongia L. sensu lato. Calfornia Plant Pest & Disease Report 18(1-2): 46-49	[Seeds may possible adhere to aquatic animals] "Individual seeds are covered with small spinules and the seeds when shed are contained in a gelatinous mass; both forms readily attach to watercraft and if they should become established in navigable waterways are likely to spread rapidly and widely."

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	"In Halophila, Hydrocharis, Limnobium, and Stratiotes the fruit is somewhat fleshy and is perhaps eaten by animals."
	Platt, S. G., Elsey, R. M., Liu, H., Rainwater, T. R., Nifong, J. C., Rosenblatt, A. E., Heithaus, M. R. and Mazzotti, F. J. 2013, Frugivory and seed dispersal by crocodilians: an overlooked form of saurochory?. Journal of Zoology, 291: 87–99	"Table 1 Fruits and seeds reported in stomach contents and feces of crocodilians" [Includes fruit & seeds of Limnobium spongia] "Table 2 Fruits consumed by crocodilians" [Includes Limnobium spongia] "Table 4 Quantity of seeds found in the stomachs of American alligators (Alligator mississippiensis) from southwestern Louisiana, Sapelo Island, Georgia and Everglades National Park, Florida" [Includes seeds of Limnobium spongia]

801	Prolific seed production (>1000/m2)	
	Source(s)	**Notes**
	Tiner, R.W. 1993. Field Guide to Coastal Wetland Plants of the Southeastern United States. University of Massachusetts Press, Amherst, MA	[Densities unknown] "somewhat roundish fleshy fruit bearing many seeds."

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	**Notes**
	Middleton, B. A. (2003). Soil seed banks and the potential restoration of forested wetlands after farming. Journal of Applied Ecology, 40(6): 1025-1034	"Some common herbaceous species of baldcypress swamps are absent in the seed banks of these fields, notably those that are primarily dispersed by vegetative organs (see Middleton 1995, 1999), including Hottonia inflata, Limnobium spongia (Bosc) L.C. Rich. ex Steud., L. minor, L. trisulca and Wolffiia columbiana."
	Royal Botanic Gardens Kew. 2008. Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/. [Accessed 11 Aug 2015]	Unknown. No storage information available

803	Well controlled by herbicides	y
	Source(s)	**Notes**
	Langeland, K., Netherland, M. & Haller, W. 2009. Efficacy of Herbicide Active Ingredients Against Aquatic Weeds. SS-AGR-44. Revised. IFAS, University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu. [Accessed 10 Aug 2015]	"Table 1. Effectiveness of Herbicide Active Ingredients for Aquatic Weed Control" [Frog's bit. Diquat & Imazapy reported to give Excellent control; Triclopyr reported to give Fair control]
	Madsen, J. D., Owens, C. S., & Getsinger, K. D. (1998). Evaluation of four herbicides for management of American frogbit (Limnobium spongia). Journal of Aquatic Plant Management, 36: 148-150	"The contact herbicide diquat gave excellent control (99- 100%) of American frogbit for all application rates, with no significant differences between rates and all rates significantly different from the untreated reference ($p < 0.01$) (Figure 1)." ... "The systemic herbicide 2,4-D gave good to excellent control of American frogbit (53 to 80% reduction in biomass) with no significant differences among treatment rates (Figure 1)." ... "Triclopyr, also a systemic herbicide gave excellent control of American frogbit at all three application rates" ...

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	California Department of Water Resources. 2015. Central Valley Flood System Conservation Strategy (Draft). California Natural Resources Agency, Sacramento, CA	"Mechanically removing all parts of the plant (i.e., shoots and stolons) can be effective if the plants have not yet produced many seeds, but physical control of a large infestation may require several years of repeated treatment."
	USDA Natural Resources Conservation Service. 2015. Conservation Plant Characteristics - Limnobium spongia. http://plants.usda.gov/java/charProfile?symbol=LISP2. [Accessed 11 Aug 2015]	"Resprout Ability: No"

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Grows in temperate to subtropical climates
• Naturalized outside native range
• Weedy smothering growth, with possible negative impacts on agriculture or the natural environment
• Limnobium laevigatum also reported to be invasive
• Tolerates shade
• Forms dense, smothering mats in fresh water bodies
• Reproduces by seeds & vegetatively
• May be dispersed by external attachment to boats or other water craft
• Sold in aquarium trade
• Seeds dispersed by waterfowl & possibly other animals

Low Risk Traits
• Unarmed (no spines, thorns or burrs)
• Non-toxic
• Ornamental
• Several herbicides provide effective control
• May be controlled mechanically